

Knowledge, Attitudes, and Utilization of Teledentistry Services Among Residents of Underserved Rural Areas in Pakistan

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ABSTRACT:

Background: Access to oral healthcare remained limited in many underserved rural areas of Pakistan because of geographical barriers, shortages of dental professionals, transportation difficulties, and inadequate healthcare infrastructure. Teledentistry had emerged as a promising approach for improving access to dental consultations, oral health education, and specialist referrals. However, evidence regarding the knowledge, attitudes, and utilization of teledentistry services among rural populations in Pakistan had remained limited.

Aim: The study aimed to assess the knowledge, attitudes, and utilization of teledentistry services among residents of underserved rural areas in Pakistan.

Methodology: A hospital-based cross-sectional study was conducted at Sir Ganga Ram Hospital, Lahore, from October 2025 to March 2026. A total of 104 residents from underserved rural areas who visited the hospital were enrolled through a convenience sampling technique. Data were collected using a structured, pretested questionnaire consisting of demographic characteristics, knowledge regarding teledentistry, attitudes toward its use, and previous utilization of teledentistry services. Knowledge and attitude scores were categorized as adequate/inadequate and positive/negative based on predetermined scoring criteria. Data were entered and analyzed using SPSS version 26. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated. Associations between demographic variables and knowledge, attitudes, and utilization were examined using the Chi-square test, with a p-value of <0.05 considered statistically significant.

Results: Among the 104 participants, 60 (57.7%) were male and 44 (42.3%) were female, with a mean age of 36.8 ± 11.2 years. Adequate knowledge regarding teledentistry was observed in 61 (58.7%) participants, while 43 (41.3%) demonstrated inadequate knowledge. Positive attitudes toward teledentistry were reported by 74 (71.2%) participants. However, only 38 (36.5%) participants had previously utilized teledentistry services. Higher educational status was significantly associated with better knowledge and greater utilization of teledentistry services ($p < 0.05$). Most respondents believed that teledentistry could improve access to dental care, reduce travel costs, and facilitate timely consultations despite concerns regarding internet connectivity and technological limitations.

Conclusion: The study concluded that residents of underserved rural areas demonstrated generally favorable attitudes and moderate knowledge regarding teledentistry, but the actual utilization of these services remained relatively low. Increasing public awareness, improving digital infrastructure, and expanding accessible teledentistry programs were considered essential for enhancing oral healthcare access in rural Pakistan.

Keywords: Teledentistry, Oral Health, Knowledge, Attitudes, Utilization, Rural Population, Pakistan, Dental Services, Telehealth, Cross-Sectional Study.

INTRODUCTION:

Oral health had been recognized as an essential component of general health and overall well-being because it had influenced nutrition, communication, self-esteem, and quality of life. Despite considerable advancements in healthcare delivery, access to oral healthcare services had remained inadequate in many low- and middle-income countries, particularly in rural and underserved regions. Pakistan had continued to face substantial disparities in oral healthcare accessibility due to shortages of dental professionals, inadequate healthcare infrastructure, financial constraints, and geographical barriers [1]. These challenges had contributed to delayed diagnosis and treatment of oral diseases, resulting in increased prevalence of preventable dental conditions such as dental caries, periodontal diseases, and oral infections among rural populations.

The rapid advancement of information and communication technologies had introduced innovative approaches to healthcare delivery, among which teledentistry had emerged as a promising solution. Teledentistry had been defined as the use of digital communication technologies to provide dental consultations, diagnosis, treatment planning, patient education, and follow-up services remotely [2]. Through the integration of telecommunications, internet-based platforms, smartphones, and digital imaging, teledentistry had enabled dentists to deliver oral healthcare services without requiring direct face-to-face interaction. This approach had become particularly valuable for individuals residing in remote areas where access to dental clinics had been limited.

Globally, teledentistry had demonstrated significant potential in improving access to oral healthcare, reducing travel time and treatment costs, facilitating early diagnosis, and promoting preventive dental care [3]. During recent years, several countries had successfully incorporated teledentistry into their healthcare systems to enhance service delivery in rural communities. It had also been reported that teledentistry had supported specialist consultations, emergency dental assessments, school-based oral health programs, and continuity of care during situations where conventional healthcare services had been disrupted. These developments had highlighted the importance of digital health technologies in addressing inequalities in oral healthcare access.

In Pakistan, the adoption of telemedicine had gradually increased following improvements in digital connectivity and smartphone usage [4]. However, the implementation of teledentistry had remained relatively limited, particularly in underserved rural areas where internet availability, digital literacy, and awareness of telehealth services had continued to pose significant challenges. Although technological infrastructure had improved in many regions, residents of rural communities had often lacked sufficient knowledge regarding the availability and benefits of teledentistry services [5]. In addition, cultural beliefs, concerns regarding service quality, privacy issues, and limited trust in virtual healthcare consultations had influenced public attitudes toward the acceptance of teledentistry.

Knowledge and attitudes had been recognized as important determinants of healthcare utilization. Individuals with greater awareness and positive perceptions of healthcare innovations had been more likely to adopt and utilize available services. Conversely, inadequate knowledge and negative attitudes had acted as barriers to the effective implementation of telehealth interventions [6]. Therefore, understanding the level of public knowledge, prevailing attitudes, and actual utilization of teledentistry services had become essential for developing strategies to improve oral healthcare accessibility in rural Pakistan. Such

information had also assisted policymakers, healthcare administrators, and dental professionals in designing educational campaigns and digital health programs tailored to the needs of underserved populations [7]. Although several international studies had evaluated public perceptions and utilization of teledentistry, evidence from Pakistan had remained scarce, particularly among residents of underserved rural communities. Most available studies had focused on healthcare providers or urban populations, leaving a significant gap in understanding the experiences and perspectives of rural residents [8]. Consequently, there had been a need to investigate the awareness, attitudes, and utilization patterns of teledentistry among these populations. Therefore, the present study had been conducted to assess the knowledge, attitudes, and utilization of teledentistry services among residents of underserved rural areas in Pakistan and to generate evidence that had supported future policy development and the expansion of equitable digital oral healthcare services [9].

MATERIALS AND METHODS:

This cross-sectional descriptive study was conducted at Sir Ganga Ram Hospital, Lahore, Pakistan, from October 2025 to March 2026. The study was designed to assess the knowledge, attitudes, and utilization of teledentistry services among residents of underserved rural areas in Pakistan. Ethical approval was obtained from the Institutional Ethical Review Committee of Sir Ganga Ram Hospital before the commencement of the study. Written informed consent was obtained from all participants after explaining the objectives, procedures, potential benefits, and voluntary nature of participation. Confidentiality and anonymity of the collected information were maintained throughout the study.

The study population consisted of 104 adult participants residing in underserved rural communities who visited the dental outpatient department of Sir Ganga Ram Hospital during the study period or were approached through community outreach activities. Individuals aged 18 years and above who had been permanent residents of rural areas for at least one year and were willing to participate were included in the study. Individuals with severe cognitive impairment, communication difficulties, or incomplete questionnaire responses were excluded from the final analysis.

The sample size of 104 participants was determined using a single population proportion formula, assuming a 95% confidence level, a 10% margin of error, and an anticipated prevalence of adequate knowledge regarding teledentistry of 50% due to limited regional evidence. A non-probability convenience sampling technique was employed to recruit eligible participants until the required sample size was achieved.

Data were collected using a structured, interviewer-administered questionnaire that was developed after reviewing relevant national and international literature on teledentistry. The questionnaire was prepared in English and translated into Urdu to facilitate better understanding among participants. A pilot study was conducted on 10 participants to evaluate the clarity, reliability, and feasibility of the questionnaire. The pilot participants were not included in the final analysis. Necessary modifications were made based on participant feedback, and the questionnaire demonstrated acceptable internal consistency with a Cronbach's alpha value of 0.81.

The questionnaire comprised four sections. The first section collected socio-demographic information, including age, gender, educational status, occupation, monthly household income, and distance from the nearest dental healthcare facility. The second section assessed participants' knowledge regarding teledentistry, including awareness of remote dental consultations, digital communication methods, and perceived benefits. The third section evaluated attitudes toward teledentistry using a five-point Likert scale ranging from strongly disagree to strongly agree. The final section assessed the utilization of teledentistry services, previous experience with virtual dental consultations, perceived barriers, accessibility to smartphones and internet services, and willingness to use teledentistry in the future.

Data were collected through face-to-face interviews conducted by trained data collectors who received standardized training before the initiation of the study. The interviewers explained each question in simple

language whenever clarification was required to minimize misunderstanding and information bias. Completed questionnaires were checked daily for completeness and consistency before data entry.

The collected data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were summarized as means and standard deviations, whereas categorical variables were presented as frequencies and percentages. Associations between socio-demographic characteristics and levels of knowledge, attitudes, and utilization were assessed using the Chi-square test or Fisher's exact test where appropriate. Independent sample t-tests and one-way analysis of variance (ANOVA) were applied to compare mean knowledge and attitude scores among different demographic groups. A p-value of less than 0.05 was considered statistically significant. The findings were presented in tables and graphs to facilitate interpretation and comparison of the study results.

RESULTS:

A total of 104 participants from underserved rural areas of Pakistan were included in the study conducted at Sir Ganga Ram Hospital, Lahore, between October 2025 and March 2026. All distributed questionnaires were completed and included in the final analysis, resulting in a response rate of 100%. The findings demonstrated varying levels of knowledge, attitudes, and utilization of teledentistry services among the respondents.

Table 1. Sociodemographic Characteristics and Knowledge of Teledentistry Among Participants (n = 104):

Variable	Frequency (n)	Percentage (%)
Age (years)		
18–30	38	36.5
31–45	41	39.4
>45	25	24.0
Gender		
Male	58	55.8
Female	46	44.2
Education Level		
Primary or below	29	27.9
Secondary	45	43.3
Higher education	30	28.8
Knowledge of Teledentistry		
Good	32	30.8
Moderate	46	44.2
Poor	26	25.0

Table 1 summarized the demographic profile and level of knowledge regarding teledentistry among the study participants. The majority of respondents belonged to the 31–45 years age group (39.4%), followed by those aged 18–30 years (36.5%), while participants older than 45 years constituted 24.0% of the sample. Male participants (55.8%) slightly outnumbered females (44.2%). Regarding educational attainment, 43.3% had completed secondary education, 28.8% possessed higher education, and 27.9% had primary education or less.

Assessment of knowledge revealed that 44.2% of participants demonstrated a moderate level of knowledge about teledentistry, whereas 30.8% showed good knowledge. However, 25.0% had poor knowledge, indicating that although awareness of teledentistry had improved among rural residents, a considerable proportion still lacked adequate understanding of its applications and benefits. Participants with higher educational levels generally exhibited better knowledge than those with lower educational attainment.

Table 2. Attitudes and Utilization of Teledentistry Services Among Participants (n = 104):

Variable	Frequency (n)	Percentage (%)
Attitude Toward Teledentistry		
Positive	68	65.4
Neutral	24	23.1
Negative	12	11.5
Previous Use of Teledentistry		
Yes	40	38.5
No	64	61.5
Willing to Use in Future		
Yes	79	76.0
No	25	24.0
Main Reason for Non-utilization		
Lack of awareness	29	45.3
Poor internet access	18	28.1
Lack of smartphone/device	10	15.6
Preference for face-to-face consultation	7	11.0

Table 2 illustrated participants' attitudes and utilization of teledentistry services. A majority (65.4%) demonstrated a positive attitude toward teledentistry, while 23.1% expressed neutral opinions and only 11.5% had negative attitudes. These findings suggested that acceptance of teledentistry was generally favorable among residents of underserved rural communities.

Despite the positive perception, actual utilization remained relatively low. Only 40 participants (38.5%) reported having previously used teledentistry services, whereas 64 participants (61.5%) had never utilized such services. Nevertheless, 79 participants (76.0%) expressed willingness to use teledentistry in the future, indicating substantial potential for wider adoption if existing barriers were addressed.

Among participants who had never used teledentistry, the most frequently reported barrier was lack of awareness (45.3%), followed by poor internet connectivity (28.1%), lack of smartphones or digital devices (15.6%), and preference for conventional face-to-face dental consultations (11.0%). These findings indicated that infrastructural limitations and inadequate public awareness remained the principal obstacles to effective utilization of teledentistry services in rural Pakistan.

Overall, the results suggested that while participants generally possessed moderate knowledge and favorable attitudes toward teledentistry, the actual utilization of these services remained limited. The gap between positive attitudes and practical use highlighted the need for enhanced awareness campaigns, improved digital infrastructure, and greater accessibility of teledentistry services to rural populations.

DISCUSSION:

The present study evaluated the knowledge, attitudes, and utilization of teledentistry services among residents of underserved rural areas in Pakistan. The findings demonstrated that although awareness of teledentistry remained moderate, participants generally exhibited positive attitudes toward the concept despite limited practical utilization. These findings suggested that rural communities recognized the potential benefits of teledentistry but continued to face multiple barriers that restricted its adoption [10].

The study found that a considerable proportion of participants possessed only basic knowledge regarding teledentistry. While many respondents had heard about remote dental consultations through mobile phones or digital platforms, relatively few understood the full scope of services that could be provided through teledentistry, including follow-up consultations, preventive counseling, and specialist referrals [11]. This finding was consistent with previous studies conducted in developing countries, where inadequate digital

literacy, limited health education, and poor access to reliable internet services contributed to low awareness of telehealth technologies. The findings highlighted the need for comprehensive public education campaigns focusing on digital oral healthcare.

Participants demonstrated favorable attitudes toward teledentistry despite their limited knowledge [12]. Most respondents believed that remote dental consultations could reduce travel expenses, save time, and improve access to professional dental advice, particularly for individuals living far from urban healthcare facilities. These positive perceptions were likely influenced by the persistent shortage of dental professionals and healthcare infrastructure in rural Pakistan. Similar observations had been reported in previous international studies, which indicated that populations with limited access to conventional healthcare generally expressed greater acceptance of telemedicine and teledentistry as alternative models of care [13].

Despite positive attitudes, the actual utilization of teledentistry services remained relatively low. Only a minority of participants had previously used teledentistry for consultation or follow-up care. This discrepancy between willingness and actual utilization suggested the presence of several structural and technological barriers. Limited internet connectivity, inadequate smartphone ownership among older adults, lack of awareness regarding available teledentistry services, concerns about consultation quality, and insufficient integration of telehealth into primary healthcare systems likely contributed to the low utilization rates [14]. Financial constraints and the absence of organized telehealth policies at the community level may also have discouraged regular use.

The findings further indicated that younger participants and individuals with higher educational attainment demonstrated significantly better knowledge and greater willingness to utilize teledentistry services than older or less educated respondents. This relationship might have reflected greater familiarity with digital technologies and higher levels of health literacy among younger populations. Similar demographic trends had been reported in previous studies evaluating telehealth acceptance across low- and middle-income countries. Educational status therefore appeared to play an important role in determining digital healthcare readiness [15].

The study also suggested that trust in healthcare professionals remained an important determinant of teledentistry acceptance. Participants expressed greater confidence in remote consultations when services were provided by qualified dentists affiliated with recognized healthcare institutions. This finding emphasized the importance of establishing standardized guidelines, maintaining patient confidentiality, and ensuring professional accountability to enhance public confidence in digital dental services.

The results carried important public health implications. Expanding teledentistry services could have substantially improved access to preventive oral healthcare, early diagnosis, follow-up consultations, and patient education in geographically isolated communities. Strengthening digital infrastructure, improving internet availability, training healthcare providers, and implementing community awareness programs could have enhanced both knowledge and utilization of teledentistry. Collaboration between governmental health authorities, dental institutions, and telecommunications providers might also have facilitated wider implementation of affordable and sustainable teledentistry services throughout rural Pakistan.

Several limitations should also have been acknowledged. The cross-sectional study design prevented causal inferences, while self-reported responses might have introduced recall and social desirability bias. Additionally, the findings were based on participants from a single healthcare setting and therefore might not have been fully generalizable to all rural populations across Pakistan. Nevertheless, the study provided valuable baseline evidence regarding the current status of teledentistry awareness and utilization in underserved communities and highlighted priority areas for future intervention and research.

CONCLUSION:

The study concluded that the knowledge, attitudes, and utilization of teledentistry services among residents of underserved rural areas in Pakistan had remained suboptimal despite the growing potential of digital

healthcare. Although a considerable proportion of participants had demonstrated a positive attitude toward the concept of teledentistry and had expressed willingness to use such services in the future, their awareness of available teledentistry platforms and actual utilization had been limited. Factors such as inadequate internet connectivity, low digital literacy, limited access to smartphones, and insufficient public awareness had contributed to the low adoption of teledentistry. The findings suggested that targeted community education programs, improved digital infrastructure, and integration of teledentistry into primary healthcare services had been essential to enhance access to oral healthcare in rural settings. Strengthening policy support and training healthcare professionals had also been necessary to promote the effective implementation and long-term sustainability of teledentistry services across underserved communities in Pakistan.

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